

## CLAIMS

We claim:

1. A method of controlling a digital communication system having a plurality of communication lines on which signals are transmitted and received, the signals being affected by interference during transmission, each of the communication lines being used by a user and having at least one transmitter and at least one receiver, the method comprising the steps of:

- collecting information about line, signal and interference characteristics of the communication lines;
- creating a model of the line, signal and interference characteristics of the communication lines;
- synchronizing transmissions of signals between transmitters and receivers;
- processing signals using the model to remove interference from signals.

2. The method of Claim 1 wherein the digital communication system is a DSL system.

3. The method of Claim 1 wherein the step of processing signals using the model is performed prior to transmission of a signal.

4. The method of Claim 1 wherein the step of processing signals using the model is performed after reception of the signals.

5. The method of Claim 1 wherein the step of synchronizing transmissions of signals comprises using block transmission and reception.

6. The method of Claim 1 wherein the interference affecting transmission of signals includes crosstalk from communication lines adjacent the communication line on which the signal is sent.

7. The method of Claim 1 wherein the digital communication system uses discrete multitone transmission and the step of processing signals using the model to remove interference from signals is done on a tone by tone basis.

8. The method of Claim 1 wherein the step of processing signals using the model to remove interference from signals comprises canceling crosstalk interference in signals by QR decomposition.

9. The method of Claim 1 wherein the step of collecting information about line, signal and interference characteristics of the communication lines is performed by a party other than one of the users.

10. The method of Claim 1 wherein each user is permitted to transmit and receive signals using a data rate and wherein the step of processing signals using the model to remove interference from signals comprises maximizing a weighted sum of the data rates of the users.

11. The method of Claim 10 wherein the step of maximizing the weighted sum of the data rates of the users comprises allocating energy to each user for transmission of signals.

12. The method of Claim 1 wherein the signals are sent using a plurality of frequencies and further wherein the step of processing signals using the model to remove interference from signals comprises dynamically adjusting the frequencies used to send the signals.

13. A method of controlling a digital communication system having a plurality of communication lines, each of the communication lines being used by a user, wherein the total power a user can use in the system is limited by a power constraint, the method comprising the steps of:

- assigning the total power constraint for each user an initial value;
- determining a competitively optimal data rate for each user, comprising the steps of:
  - determining a power allocation within the total power constraint of each user by iteratively allowing each user to optimize its power allocation; and

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- determining the competitively optimal data rate for each user based on the determined power allocation for the user;
  - evaluating the competitively optimal data rate for each user, comprising the steps of:
    - comparing the competitively optimal data rate of a user with a target rate for the user;
    - increasing the power constraint for a user if the competitively optimal data rate of the user is less than the target rate for the user;
    - decreasing the power constraint for the user if the competitively optimal data rate of the user exceeds the target rate for the user by at least a prescribed variance;
    - maintaining the power constraint for the user if the competitively optimal data rate of the user is equal to the target rate for the user; and
    - maintaining the power constraint for the user if the competitively optimal data rate of the user exceeds the target rate for the user by less than the prescribed variance.

14. The method of Claim 13 wherein the steps of determining a competitively optimal data rate for each user and evaluating the power constraint for each user are repeated until no power constraint is increased or decreased.

15. The method of Claim 13 wherein the digital communication system is a DSL system.

16. The method of Claim 13 wherein the total power allowed each user is allocated among a plurality of frequencies.

17. The method of Claim 13 performed by a single entity.

18. The method of Claim 13 performed by the users in a distributed fashion.

19. The method of Claim 13 wherein crosstalk interference is injected into the communication line of a user by at least one of the lines of another user and further

wherein the crosstalk interference is considered by a user in the step of determining the power allocation of the user.

20. The method of Claim 13 wherein each user uses a modem having a power limit and wherein the power constraint of a user will not be increased to a level greater than the modem power limit irrespective of the competitively optimal data rate of the user.

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